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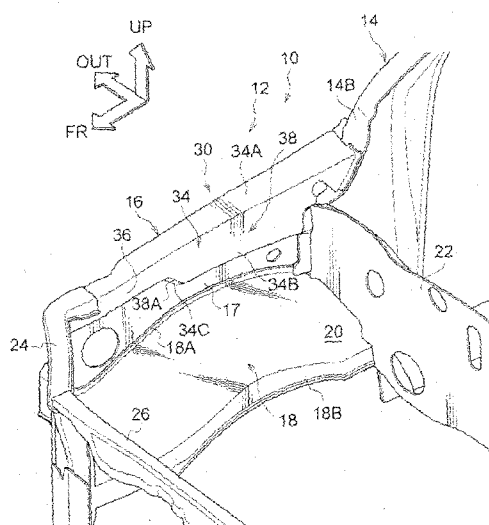


FIG. 1

(57) Abstract: A vehicle front structure (30) includes an apron upper member (16) that extends in a vehicle front-rearward direction and is provided on a vehicle front side of an intermediate portion (14B) of a front pillar (14) in a vehicle vertical direction. A high strength portion (38) is provided on a rear portion side of the apron upper member (16) in the vehicle front-rearward direction. This high strength portion (38) provides a strength difference by increasing the strength of the rear portion side of the apron upper member (16) such that the strength of the rear portion side is greater than the strength of a front portion side (36) in the vehicle front-rearward direction.

VEHICLE FRONT STRUCTURE

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The invention relates to a vehicle front structure.

2. Description of Related Art

[0002] Japanese Patent Application Publication No. 2011-162103 (JP 2011-162103 A) describes a structure in which a reinforcement is provided on a vehicle front-rearward direction rear portion side on a vehicle upper side of an apron upper member. Also, when the vehicle is viewed from a side, the apron upper member has a shape in which a sectional area gradually increases from the vehicle front portion side toward the vehicle rear portion side.

[0003] With the technology described in JP 2011-162103 A, a load is effectively received when the vehicle is involved in a frontal collision, by adding a reinforcement to the rear portion side on the vehicle upper side of the apron upper member. However, with only the reinforcement of the apron upper member, the load transmitted to a front pillar on the vehicle rear side of the apron upper member will increase, so there is room for improvement with respect to reducing a moment that is generated in the front pillar.

SUMMARY OF THE INVENTION

[0004] The invention provides a vehicle front structure capable of suppressing a moment that is generated in a front pillar when a vehicle is involved in a frontal collision.

[0005] A first aspect of the invention relates to a vehicle front structure that includes an apron upper member that is provided on a vehicle front side of a vehicle vertical direction intermediate portion of a front pillar, and extends in a vehicle front-rearward direction; and a high strength portion that is provided on a rear portion side of the apron upper member in the vehicle front-rearward direction, and that provides a

strength difference by increasing a strength of the rear portion side such that the strength of the rear portion side is greater than a strength of a front portion side of the apron upper member in the vehicle front-rearward direction.

[0006] The high strength portion that provides the strength difference by increasing the strength of the rear portion side such that the strength of the rear portion side is greater than the strength of the front portion side in the vehicle front-rearward direction, is provided on the rear portion side of the apron upper member in the vehicle front-rearward direction. As a result, when a load from the vehicle front side is applied to the apron upper member when the vehicle is involved in a frontal collision, the portion of the front portion side that is weaker than the high strength portion of the rear portion side of the apron upper member, will deform (bend) downward in the vehicle vertical direction, so force that pushes the portion of the high strength portion of the apron upper member upward in the vehicle vertical direction is generated. Therefore, some of the moment generated in the front pillar is able to be suppressed by the front side of the front pillar being pushed upward in the vehicle vertical direction.

[0007] In the vehicle front structure described above, the high strength portion may be configured to include a step portion that is bent toward a vehicle lower side such that a sectional area of the rear portion side is larger than a sectional area of the front portion side, and may be on a lower portion side of the apron upper member in a vehicle vertical direction.

[0008] The high strength portion includes the step portion that is bent toward the vehicle lower side such that the sectional area of the rear portion side is larger than the sectional area of the front portion side of the apron upper member. As a result, when a load from the vehicle front side is applied to the apron upper member when the vehicle is involved in a frontal collision, compression stress concentrates at a lower boundary portion between the step portion and the front portion side of the apron upper member, the lower boundary portion has the strength difference between the step portion and the front portion side of the apron upper member, so the portion of the front portion side will more easily deform (more easily bend) downward in the vehicle vertical direction than the step portion

of the apron upper member will. Therefore, some of the moment generated in the front pillar is able to be more effectively suppressed by the generation of force that pushes the portion of the high strength portion of the apron upper member upward in the vehicle vertical direction.

[0009] In the vehicle front structure described above, the high strength portion may be configured such that a plate thickness of the rear portion side of the apron upper member is thicker than a plate thickness of the front portion side of the apron upper member.

[0010] The high strength is configured such that the plate thickness of the rear portion side of the apron upper member is thicker than the plate thickness of the front portion side of the apron upper member. As a result, when a load from the vehicle front side is applied to the apron upper member when the vehicle is involved in a frontal collision, the thin portion of the front portion side that is weaker than the thick portion on the rear portion side of the apron upper member, will more easily deform (more easily bend) downward in the vehicle vertical direction. Therefore, some of the moment generated in the front pillar is able to be more effectively suppressed by the generation of force that pushes the portion of the high strength portion of the apron upper member upward in the vehicle vertical direction.

[0011] In the vehicle front structure described above, the high strength portion may be shaped such that a sectional area becomes wider toward a vehicle rear side.

[0012] The high strength portion of the apron upper member is shaped such that the sectional area becomes wider toward the vehicle rear side, so the strength of the high strength portion increases farther toward the vehicle rear side. Therefore, the portion of the front portion side is more reliably able to be made to deform downward in the vehicle vertical direction with respect to the high strength portion of the rear portion side of the apron upper member.

[0013] According to the vehicle front structure of this aspect of the invention, a moment generated in the front pillar is able to be suppressed when a vehicle is involved in a frontal collision.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] Features, advantages, and technical and industrial significance of exemplary embodiments of the invention will be described below with reference to the accompanying drawings, in which like numerals denote like elements, and wherein:

FIG. 1 is a perspective view of a vehicle front structure according to a first example embodiment of the invention, shown from a vehicle front side;

FIG. 2 is a side view of an area near an apron upper member used in the vehicle front structure of the first example embodiment, shown from a vehicle inside;

FIG. 3A is a sectional view of the vehicle front structure taken along line 3A – 3A in FIG. 2;

FIG. 3B is a sectional view of the vehicle front structure taken along line 3B – 3B in FIG. 2;

FIG. 4 is a side view illustrating a deformed state of the vehicle front structure according to the first example embodiment when a frontal collision occurs;

FIG. 5 is a side view of an area near an apron upper member used in a vehicle front structure according to a second example embodiment of the invention, shown from the vehicle inside;

FIG. 6A is a side view of an area near an apron upper member used in a vehicle front structure according to a third example embodiment of the invention, shown from the vehicle inside;

FIG. 6B is a sectional view taken along line 6B – 6B in FIG. 6A;

FIG. 7 is a side view illustrating a deformed state of the vehicle front structure according to the third example embodiment when a frontal collision occurs; and

FIG. 8 is a side view illustrating a deformed state of a vehicle front structure according to a comparative example when a frontal collision occurs.

DETAILED DESCRIPTION OF EMBODIMENTS

[0015] Hereinafter, a first example embodiment of the vehicle front structure

according to the invention will be described with reference to FIGS. 1 to 4. In the drawings, arrow FR indicates a forward direction with respect to the vehicle, arrow UP indicates an upward direction with respect to the vehicle, and arrow OUT indicates an outside in a vehicle width direction.

[0016] FIG. 1 is a perspective view of an area near an apron upper member of a front portion of a vehicle to which a vehicle front structure 30 of this example embodiment is applied. FIG. 2 is a side view of the area near the apron upper member of the front portion of the vehicle to which the vehicle front structure 30 is applied, as viewed from the vehicle inside. In FIGS. 1 and 2, only one end side in the vehicle width direction (i.e., the left side in the vehicle width direction when the vehicle is viewed from the front) is shown. The other end side in the vehicle width direction (i.e., the right side in the vehicle width direction when the vehicle is viewed from the front) is bilaterally symmetrical with the one end side, and thus is not shown.

[0017] As shown in FIGS. 1 and 2, a front pillar 14 that extends in substantially the vehicle vertical direction is provided on a front portion 12 of a vehicle 10 to which the vehicle front structure 30 is applied. The front pillar 14 has an intermediate portion 14B in the vehicle vertical direction that extends downward at an oblique angle toward the front of the vehicle from a vehicle upper portion 14A (see FIG. 4). An apron upper member 16 that extends in substantially the vehicle front-rearward direction is provided on the vehicle front side of the intermediate portion 14B of the front pillar 14. In this example embodiment, a rear end portion of the apron upper member 16 is connected to the intermediate portion 14B of the front pillar 14, but the rear end of the apron upper member 16 may also be connected to the intermediate portion 14B of the front pillar 14 via another member. Although not shown, the front pillar 14 and the apron upper member 16 are provided in a pair on both the left and right sides of the vehicle 10.

[0018] An apron front panel 18 that extends in substantially the vehicle width direction and substantially the vehicle front-rearward direction is provided via a vertical wall portion 17, on the vehicle lower side and the vehicle width direction inside of the apron upper member 16. An engine room 20 is provided between the left and right pairs

of apron upper members 16, in the front portion 12 of the vehicle 10. A dash panel 22 that extends in substantially the vehicle width direction and substantially the vehicle vertical direction is provided to the vehicle rear side of the engine room 20. An upper frame 26 that extends in substantially the vehicle width direction is arranged, via an upper extending portion 24 that extends inward at an oblique angle toward the front of the vehicle, on the vehicle front side of the apron upper member 16. Although not shown, a cowl portion that extends in substantially the vehicle width direction is provided on the vehicle upper side of the dash panel 22. Also, although not shown, a front side member that extends in substantially the vehicle front-rearward direction is provided on the vehicle width direction inside of the apron front panel 18.

[0019] As shown in FIG. 4, a roof side rail 40 that is connected to the vehicle upper portion 14A of the front pillar 14 and extends in substantially the vehicle front-rearward direction is provided on a side portion of the vehicle 10. The front pillar 14 is arranged along a vehicle front edge of a front door open portion 42 provided in the side portion of the vehicle 10. Also, a center pillar 44 that extends in substantially the vehicle vertical direction is connected to a center portion of the roof side rail 40 in the vehicle front-rearward direction.

[0020] FIG. 3A is a sectional view of the vehicle front structure 30 taken along line 3A – 3A in FIG. 2, and FIG. 3B is a sectional view of the vehicle front structure 30 taken along line 3B – 3B in FIG. 2. As shown in FIGS. 3A and 3B, the apron upper member 16 includes an apron upper member outer 32 arranged on the vehicle width direction outside, and an apron upper member inner 34 arranged to the vehicle width direction inside of the apron upper member outer 32. In a sectional view taken along the vehicle width direction, the upper portion side of the apron upper member inner 34 in the vehicle vertical direction is formed in a general U-shape that opens to the vehicle width direction outside. More specifically, the apron upper member inner 34 includes an upper wall portion 34A arranged in substantially the vehicle width direction and substantially the vehicle front-rearward direction, a vertical wall portion 34B that extends to substantially the vertical lower side from a vehicle width direction inside end portion of the upper wall

portion 34A, and a lower side wall portion 34C that is curved toward substantially the vehicle width direction outside from a lower end portion of the vertical wall portion 34B and extends at an oblique angle toward the lower side with respect to the vehicle. The vertical wall portion 17 extends from the vehicle width direction outside end portion toward substantially the vehicle lower side, on this lower side wall portion 34C (see FIGS. 1 and 2).

[0021] Also, the apron upper member outer 32 is formed in a general L-shape, and includes an upper wall portion 32A that is arranged in substantially the vehicle width direction and substantially the vehicle front-rearward direction, and a vertical wall portion 32B that extends toward substantially the vehicle lower side from a vehicle width direction inside end portion of the upper wall portion 32A. A vehicle width direction outside end portion of the upper wall portion 34A of the apron upper member inner 34 is joined by welding or the like to an upper surface of the upper wall portion 32A of the apron upper member outer 32, and an upper end portion of the vertical wall portion 17 is joined by welding or the like to a lower end portion 32C of the vertical wall portion 32B. As a result, the apron upper member 16 is a closed sectional structure by the upper portion side of the apron upper member inner 34 and the apron upper member outer 32 (see FIGS. 1 and 2).

[0022] The apron front panel 18 includes a flange portion 18A that is bent toward the vehicle upper side from the vehicle width direction outside end portion. This flange portion 18A is joined by welding or the like to a lower end portion of the vertical wall portion 17 of the apron upper member inner 34. The apron front panel 18 also includes a vertical wall portion 18B that is bent toward the vehicle lower side from the vehicle width direction inside end portion.

[0023] As shown in FIGS. 1 to 3A and 3B, a high strength portion 38 is provided on a rear portion side of the apron upper member 16 in the vehicle front-rearward direction. This high strength portion 38 provides a strength difference by increasing the strength of the rear portion side so that it is greater than the strength of the front portion side 36 in the vehicle front-rearward direction. More specifically, as shown in FIGS. 1 and 2, the high

strength portion 38 includes a step portion 38A that is bent toward the vehicle lower side from a rear end lower portion of the front portion side 36 of the apron upper member 16 in a vehicle side view.

[0024] That is, the upper wall portion 34A is formed continuous in the vehicle front-rearward direction with the front portion side 36 of the apron upper member 16 and the high strength portion 38 that is to the rear of the front portion side 36 of the apron upper member 16. Also, in a vehicle side view, the vertical wall portion 34B of the high strength portion 38 is formed such that the area becomes wider by the step portion 38A, with respect to the vertical wall portion 34B of the front portion side 36 of the apron upper member 16 (see FIGS. 1 and 2). Further, in a vehicle side view, the lower side wall portion 34C of the high strength portion 38 of the apron upper member 16 curves toward the vehicle lower side by the step portion 38A with respect to the lower side wall portion 34C of the front portion side 36 (see FIGS. 1 and 2). By this step portion 38A, the high strength portion 38 has a shape that is broader toward the vehicle lower side than the front portion side 36 of the apron upper member 16.

[0025] As a result, the sectional area in the vehicle width direction of the high strength portion 38 that forms the closed section of the apron upper member 16 is larger than the sectional area in the vehicle width direction of the front portion side 36, as shown in FIGS. 3A and 3B. Further, in a vehicle side view, the high strength portion 38 of the apron upper member 16 has a shape in which the sectional area widens from the vehicle front side toward the vehicle rear side (see FIG. 2). By having the high strength portion 38 of the apron upper member 16 be shaped such that the sectional area of the high strength portion 38 is larger than the sectional area of the front portion side 36, the front portion side 36 (i.e., the section of the front portion side 36) will deform (i.e., bend in an upward protruding shape) toward the vehicle lower side with respect to the high strength portion 38 of the apron upper member 16, when a load from the vehicle front side is applied to the apron upper member 16 when the vehicle 10 is involved in a frontal collision.

[0026] The apron upper member 16 is arranged in a relatively high position in the

vertical direction of the front portion 12 of the vehicle 10. The front end portion of the apron upper member 16 is arranged inclined farther toward the vehicle lower side than the rear end portion of the apron upper member 16 is (see FIG. 2).

[0027] Here, a vehicle front structure 104 of a comparative example will be described with reference to FIG. 8, before describing the operation and effects of the vehicle front structure 30 of this example embodiment.

[0028] An apron upper member 106 that extends in the vehicle front-rearward direction on a vehicle front side of an intermediate portion 14B of a front pillar 14 in the vehicle vertical direction, is provided on a front portion 102 of a vehicle 100 to which the vehicle front structure 104 is applied. Although not shown, the apron upper member 106 is a closed sectional structure, and the sectional area in substantially the vehicle front-rearward direction (i.e., the sectional area in the vehicle width direction) is formed approximately the same size at a front portion side 106A and a rear portion side 106B in the vehicle front-rearward direction. That is, with this vehicle front structure 104, the strength of the front portion side 106A and the rear portion side 106B of the apron upper member 106 is set approximately the same, and a high strength portion that is stronger than the front portion side 106A is not provided on the rear portion side 106B of the apron upper member 106.

[0029] With this kind of vehicle front structure 104, when the front portion 102 of the vehicle 100 collides with a colliding object 50, deformation may occur in the front pillar 14 by input from a tire 108 and the apron upper member 106, as shown in FIG. 8. That is, when the vehicle 100 is involved in a frontal collision, the front pillar 14 is pushed in the direction of arrow 110A by the tire 108, and as well as pushed in the direction of arrow 110B by the apron upper member 106. That is, the front pillar 14 receives the load and is decelerated, while the roof side rail 40 continues to move toward the front of the vehicle (i.e., in the direction of arrow 112) by inertia force. Therefore, the space between the intermediate portion 14B of the front pillar 14 and a connecting portion 40A of the roof side rail 40 that is connected to the center pillar 44 degenerates, so a downward compression moment indicated by arrow 114 acts on the front pillar 14. As a result,

deformation may occur in the front pillar 14.

[0030] Next, the operation and effects of the vehicle front structure 30 of this example embodiment will be described.

[0031] In the vehicle front structure 30, the high strength portion 38 is provided on the rear portion side of the apron upper member 16 in the vehicle front-rearward direction, as shown in FIGS. 1 and 2 and the like. This high strength portion 38 provides a strength difference by increasing the strength of the rear portion side so that it is greater than the strength of the front portion side 36. The high strength portion 38 includes the step portion 38A that is bent toward the vehicle lower side such that the sectional area of the rear portion side of the apron upper member 16 becomes larger than the sectional area of the front portion side 36 of the apron upper member 16. The high strength portion 38 has a shape that becomes broader toward the vehicle lower side of the apron upper member 16. As a result, when the front portion 12 of the vehicle 10 collides with the colliding object 50 and a load from the vehicle front side is applied to the apron upper member 16, compression stress concentrates at a lower boundary portion of the step portion 38A and the front portion side 36 of the apron upper member 16, and a portion of the front portion side 36 will deform downward in the vehicle vertical direction with respect to the high strength portion 38, as shown in FIG. 4. That is, a rear end of the front portion side 36 of the apron upper member 16 will bend in an upward protruding shape with respect to the high strength portion 38.

[0032] At this time, an upward load is transmitted to the front portion side 36 of the apron upper member 16, as indicated by arrow 52, by the portion of the front portion side 36 of the apron upper member 16 protruding downward. Although not shown, when the vehicle 10 is involved in a frontal collision, an upward load that acts on the front portion side 36 of the apron upper member 16 becomes larger by a lower portion side of the colliding object 50 or the like penetrating toward the vehicle lower side of the front portion side 36 of the apron upper member 16.

[0033] As a result, a moment that compresses the upper surface of the high strength portion 38 indicated by arrow 54, or a load that pushes the high strength portion

38 upward in the vehicle vertical direction as indicated by arrow 56, is generated in the high strength portion 38 of the apron upper member 16. Some of the moment generated in the front pillar 14 (i.e., the downward compressing moment indicated by arrow 114) is offset and reduced by the moment that compresses the upper surface of the high strength portion 38, indicated by arrow 54, or a load that pushes the high strength portion 38 upward in the vehicle vertical direction as indicated by arrow 56, being transmitted to the front pillar 14, and the front side of the front pillar 14 consequently being pushed upward in the vehicle vertical direction. As a result, the deformation amount of the front pillar 14 is able to be reduced, so deformation of the cabin of the vehicle 10 is able to be suppressed.

[0034] Also, with the vehicle front structure 30 of this example embodiment, the high strength portion 38 of the apron upper member 16 has a shape in which the sectional area becomes wider from the vehicle front side toward the vehicle rear side, and the strength increases toward the vehicle rear side. As a result, the high strength portion 38 retains sufficient strength, so the portion of the front portion side 36 is able to be made to more reliably deform (i.e., bend in an upward protruding shape) downward in the vehicle vertical direction with respect to the high strength portion 38 of the apron upper member 16 when the vehicle 10 is involved in a frontal collision.

[0035] Next, a second example embodiment of the vehicle front structure according to the invention will be described with reference to FIG. 5. Component parts similar to those in the first example embodiment described above will be denoted by like reference characters, and descriptions of those parts will be omitted.

[0036] As shown in FIG. 5, with a vehicle front structure 60, a high strength portion 66 is provided on a rear portion side in the vehicle front-rearward direction of an apron upper member 62 that forms a closed cross-section. This high strength portion 66 provides a strength difference by increasing the strength of the rear portion side so that it is greater than the strength of a front portion side 64 in the vehicle front-rearward direction. The high strength portion 66 is formed by a member that is separate from the front portion side 64 of the apron upper member 62. More specifically, the front portion side 64 of the apron upper member (apron upper member inner) 62 includes an upper wall portion 34A, a

vertical wall portion 34B, and a lower side wall portion 34C, as described above. The high strength portion 66 includes an upper wall portion 66A that is arranged in substantially the vehicle width direction and substantially the vehicle front-rearward direction, a vertical wall portion 66B that extends toward the vehicle lower side from a vehicle width direction inside end portion of the upper wall portion 66A, and a lower side wall portion 66C that is bent downward at an oblique angle toward the vehicle width direction outside from a lower end portion of the vertical wall portion 66B.

[0037] A step portion 66D that is bent toward the vehicle lower side from the front portion side 64 of the apron upper member 62 is formed on a front end portion of the vertical wall portion 66B. Further, the high strength portion 66 has a flange portion 66E that is bent toward the vehicle front side or the vehicle lower side, formed on an edge portion of the step portion 66D and the lower side wall portion 66C.

[0038] Although not shown, a rear end portion of the front portion side 64 of the apron upper member 62 is arranged overlapping with a front end portion of the high strength portion 66. Also, front end portions of the upper wall portion 66A and the vertical wall portion 66B of the high strength portion 66 are joined by welding or the like to rear end portions of the upper wall portion 34A and the vertical wall portion 34B of the front portion side 64 of the apron upper member 62, and the flange portion 66E of the high strength portion 66 is joined by welding or the like to the vertical wall portion 17 of the apron upper member 62.

[0039] Also, although not shown, in this example embodiment, an apron upper member outer is formed with the front portion side 64 and a rear portion side divided, but the embodiment is not limited to this. That is, the front portion side 64 and the rear portion side may also be integrally formed.

[0040] With this kind of vehicle front structure 60, when a load from the vehicle front side is applied to the apron upper member 62 when the vehicle 10 is involved in a frontal collision, the portion of the front portion side 64 will deform (i.e., bend in an upward protruding shape) downward in the vehicle vertical direction with respect to the high strength portion 66 of the apron upper member 62. As a result, an upward load is

transmitted to the front portion side 64 of the apron upper member 62, so a moment that compresses the upper surface, or a load that pushes the high strength portion 66 upward in the vehicle vertical direction, is generated in the high strength portion 66 on the rear portion side of the apron upper member 62. Consequently, the front side of the front pillar 14 is pushed upward in the vehicle vertical direction, so some of the moment (i.e., the downward compression moment) generated in the front pillar 14 is able to be suppressed.

[0041] Also, with the vehicle front structure 60, having the high strength portion 66 formed by a separate member from the front portion side 64 of the apron upper member 62 makes it easier to set the shape of the high strength portion 66, and a moment that compresses the upper surface, or a load that pushes the high strength portion 66 upward in the vehicle vertical direction, is able to be generated as planned in the high strength portion 66 of the apron upper member 62.

[0042] Next, a third example embodiment of the vehicle front structure according to the invention will be described with reference to the FIGS. 6A and 6B, and FIG. 7. Component parts that are similar to those in the first and second example embodiments described above will be denoted by like reference characters, and descriptions of those parts will be omitted.

[0043] As shown in FIG. 6A, in a vehicle front structure 70, an apron upper member (a closed sectional portion) 72 has substantially the same sectional area in substantially the vehicle front-rearward direction in a vehicle side view. A high strength portion 76 is provided on a rear portion side of the apron upper member 72 in the vehicle front-rearward direction. This high strength portion 76 provides a strength difference by increasing the strength of the rear portion side so that it is greater than the strength of a front portion side 74 in the vehicle front-rearward direction.

[0044] FIG. 6B is a sectional view of the apron upper member 72 taken along line 6B – 6B in FIG. 6A. As shown in FIG. 6B, a plate thickness of the high strength portion 76 of the apron upper member 72 is thicker than the plate thickness of the front portion side 74 of the apron upper member 72. The high strength portion 76 is set to almost the

entire portion that is a closed section on the rear portion side of the apron upper member 72 in a vehicle side view (see FIG. 6A). With the apron upper member 72 of this example embodiment, the thick high strength portion 76 is integrated with the thin front portion side 74 by different thickness joining at a joining portion 76A.

[0045] Here, different thickness joining refers to so-called tailored blank welding, in which a plurality of metal sheets (blanks) of different thicknesses (or materials) are welded together by laser welding or the like to form a single sheet. For example, by using different thickness joining on a press forming member of a vehicle body, the plate thickness is able to be increased only at the portions where strength is required, so the property of a single sheet of material is able to be changed at some parts.

[0046] With this kind of vehicle front structure 70, the high strength portion 76 that provides a strength difference by increasing the strength of the rear portion side in the vehicle front-rearward direction so that it is greater than the strength of the front portion side 74 is provided on the upper portion side of the apron upper member 72. Therefore, as shown in FIG. 7, when a load from the vehicle front side is applied to the apron upper member 72 when the vehicle 10 is involved in a frontal collision, the portion of the front portion side 74 deforms (i.e., bends in an upward protruding shape) downward in the vehicle vertical direction with respect to the high strength portion 76 of the apron upper member 72. At this time, the apron upper member 72 is in a relatively high position in the vertical direction of the vehicle 10, and the front end portion of the apron upper member 72 is inclined farther downward in the vehicle vertical direction than the rear end portion of the apron upper member 72 is, so the portion of the front portion side 74 is more easily able to bend downward in the vehicle vertical direction with respect to the high strength portion 76 of the apron upper member 72.

[0047] As a result, as indicated by arrow 52, an upward load is transmitted to the front portion side 74 of the apron upper member 72, so a moment that compresses the upper surface of the high strength portion 76, indicated by arrow 54, or a load that pushes the high strength portion 76 upward in the vehicle vertical direction, as indicated by arrow 56, is generated in the high strength portion 76 on the rear portion side of the apron upper

member 72. Some of the moment generated in the front pillar 14 (i.e., the downward compression moment) is able to be suppressed by the front side of the front pillar 14 being pushed upward in the vehicle vertical direction as a result of this kind of moment that compresses the upper surface of the high strength portion 76, as indicated by arrow 54, or the load that pushes the high strength portion 76 upward in the vehicle vertical direction, as indicated by arrow 56. As a result, the deformation amount of the front pillar 14 is able to be reduced, so deformation of the cabin of the vehicle 10 is able to be suppressed.

[0048] Also, in this example embodiment, the high strength portion 76 that has a thicker plate thickness than the plate thickness of the front portion side 74 is joined by different thickness joining at the joining portion 76A, so the high strength portion 76 is able to be set without changing the sectional area of the apron upper member 72 in the vehicle front-rearward direction.

[0049] In this vehicle front structure 70, the apron upper member (a closed sectional portion) 72 has substantially the same sectional area in the vehicle front-rearward direction in a vehicle side view, but the embodiment is not limited to this. For example, the high strength portion on the rear portion side of the apron upper member may also be shaped such that the sectional area becomes wider from the vehicle front side toward the vehicle rear side. As a result, the strength of the high strength portion increases from the vehicle front side toward the vehicle rear side, so the portion on the front portion side will more reliably tend to deform (tend to bend) downward in the vehicle vertical direction with respect to the high strength portion on the rear portion side of the apron upper member.

[0050] Also, in the vehicle front structure 70, the high strength portion on the rear portion side is joined by different thickness joining to the front portion side of the apron upper member, so the plate thickness of the high strength portion is thicker than the plate thickness of the front portion side, but the embodiment is not limited to this. For example, when the plate thickness of the entire apron upper member is the same, a high strength portion that provides a strength difference by increasing the strength of the rear portion side so that it is greater than the strength of the front portion side may be formed by joining a reinforcing member to the rear portion side of the apron upper member by welding (for

example, spot welding) or the like. That is, the plate thickness of the entire rear portion side of the apron upper member is able to be made thicker than the plate thickness of the front portion side of the apron upper member by joining the reinforcing member to the rear portion side of the apron upper member.

[0051] In the first and second example embodiments, as long as the high strength portion of the apron upper member is shaped such that the sectional area is larger than the sectional area of the front portion side of the apron upper member, the size of this sectional area may be changed.

[0052] Also, in the first and second example embodiments, the sectional area of the high strength portion of the apron upper member is larger on the vehicle lower side than the sectional area of the front portion side of the apron upper member, but the embodiment is not limited to this structure. For example, the sectional area of the high strength portion of the apron upper member may also be larger in the vehicle width direction than the sectional area of the front portion side of the apron upper member.

[0053] Also, in the third example embodiment, as long as the plate thickness of the high strength portion of the apron upper member is thicker than the plate thickness of the front portion side of the apron upper member, the plate thickness ratio may be changed.

CLAIMS:

1. A vehicle front structure comprising:

apron upper member that is provided on a vehicle front side of a vehicle vertical direction intermediate portion of a front pillar, and extends in a vehicle front-rearward direction; and

a high strength portion that is provided on a rear portion side of the apron upper member in the vehicle front-rearward direction, and that provides a strength difference by increasing a strength of the rear portion side such that the strength of the rear portion side is greater than a strength of a front portion side of the apron upper member in the vehicle front-rearward direction.

2. The vehicle front structure according to claim 1, wherein

the high strength portion includes a step portion on a lower portion side of the apron upper member in a vehicle vertical direction; and

the high strength portion is bent toward a vehicle lower side such that a sectional area of the rear portion side is larger than a sectional area of the front portion side.

3. The vehicle front structure according to claim 1, wherein

the high strength portion is configured such that a plate thickness of the rear portion side of the apron upper member is thicker than a plate thickness of the front portion side of the apron upper member.

4. The vehicle front structure according to claim 2 or 3, wherein

the high strength portion is shaped such that a sectional area becomes wider toward a vehicle rear side.

FIG. 1

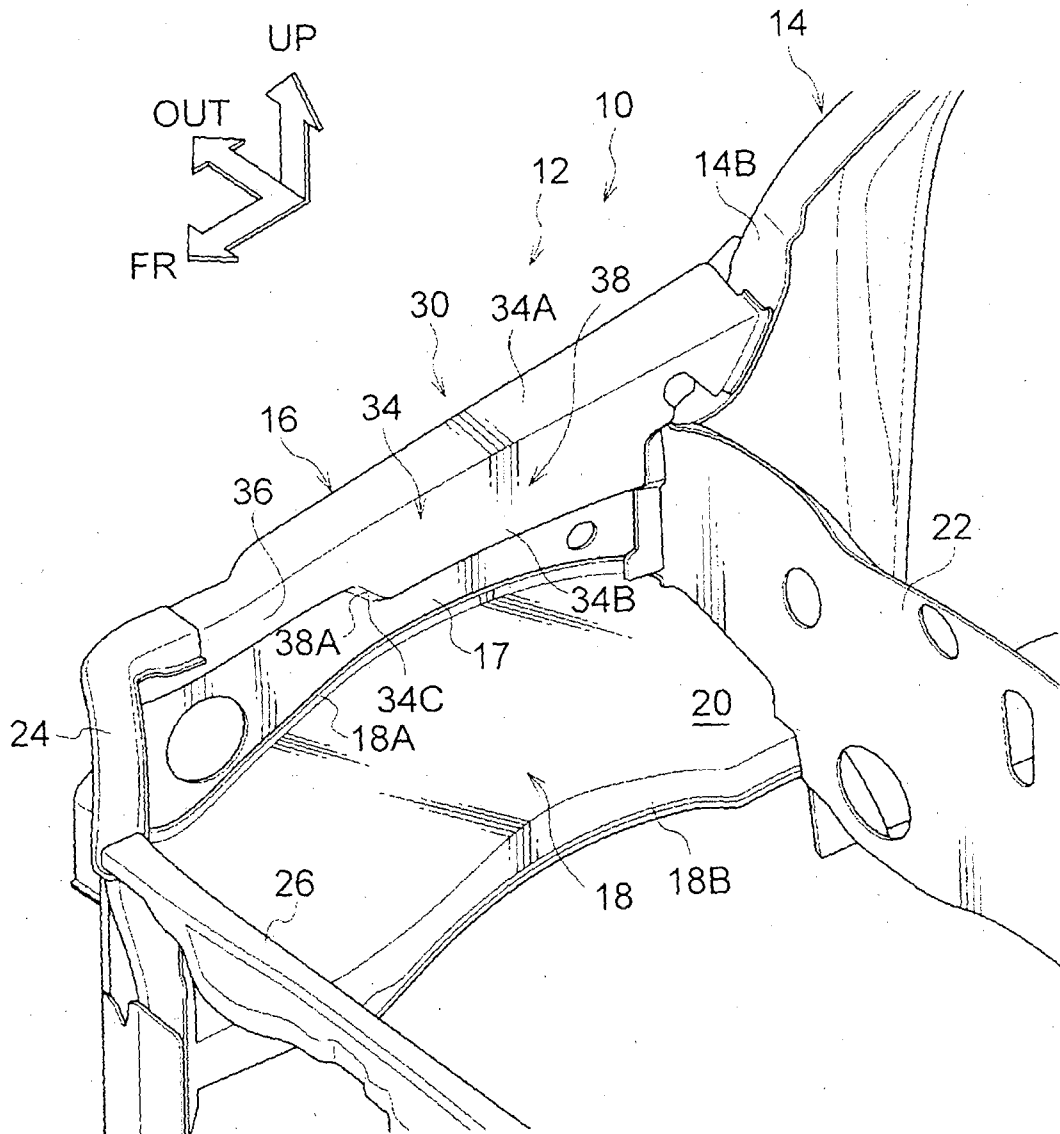


FIG. 2

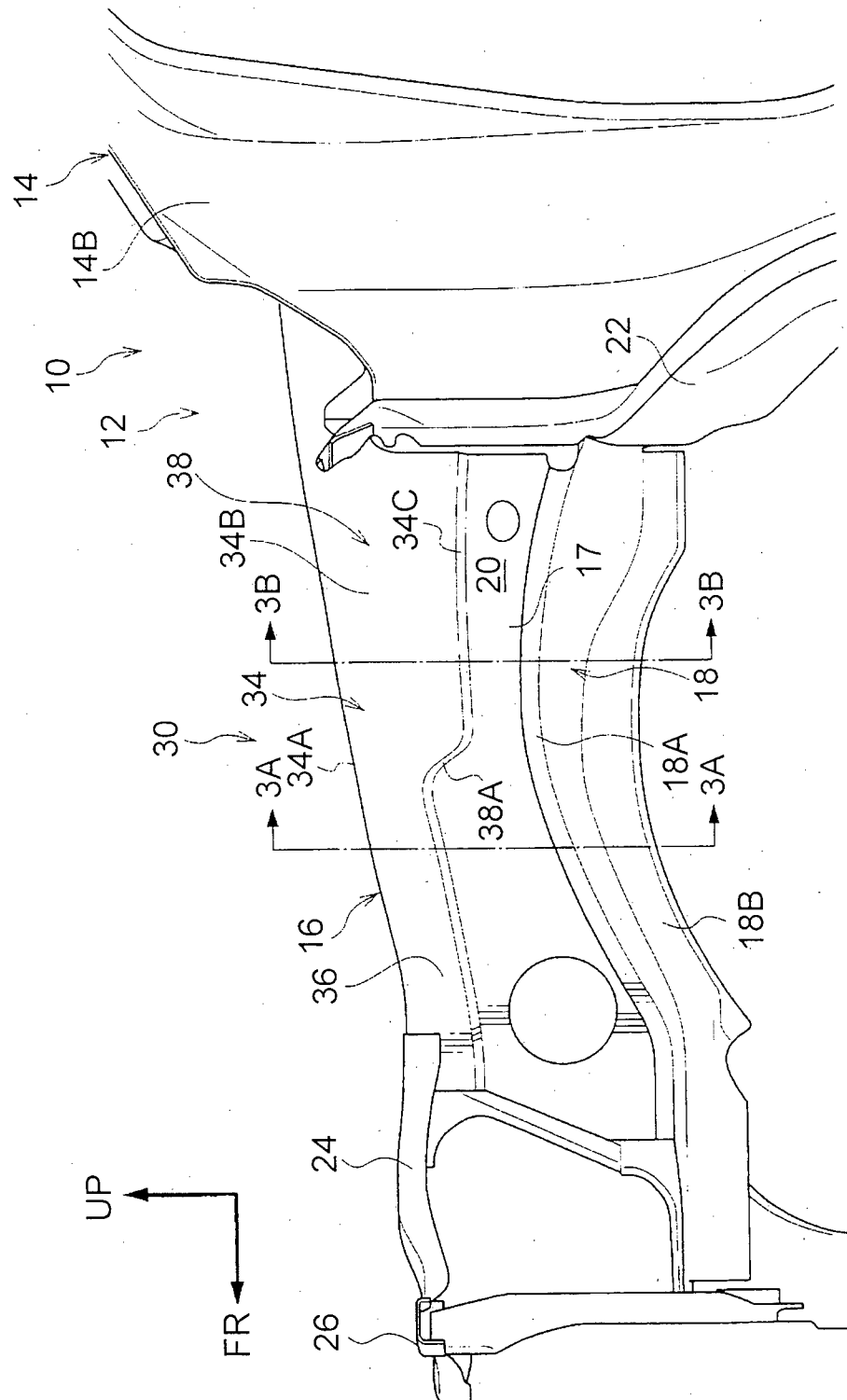


FIG. 3A

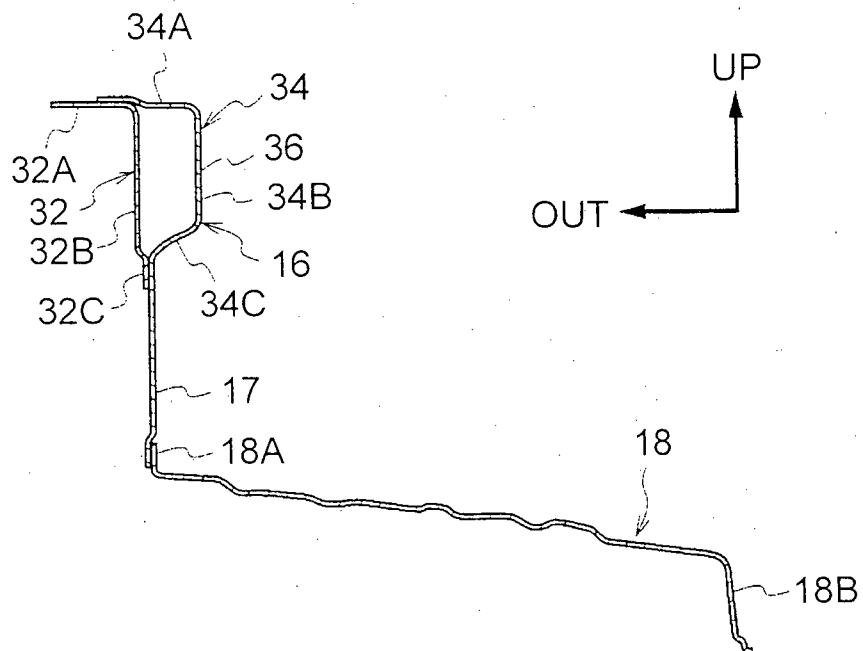


FIG. 3B

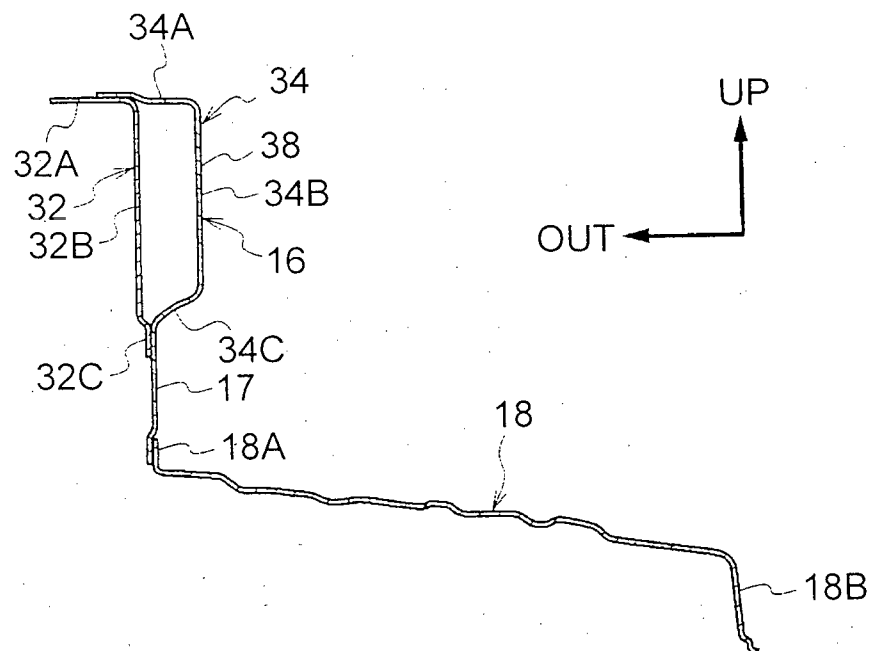


FIG. 4

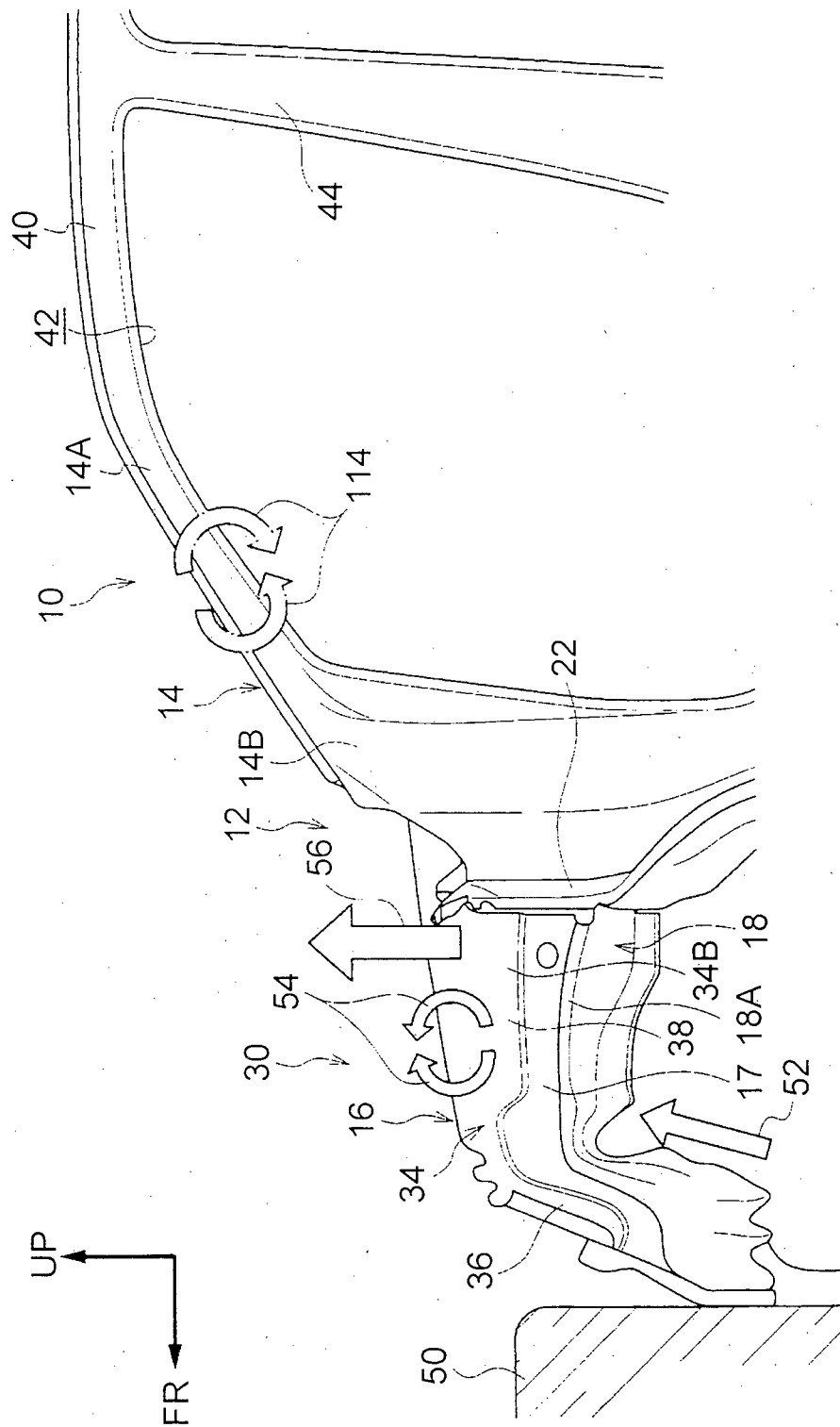
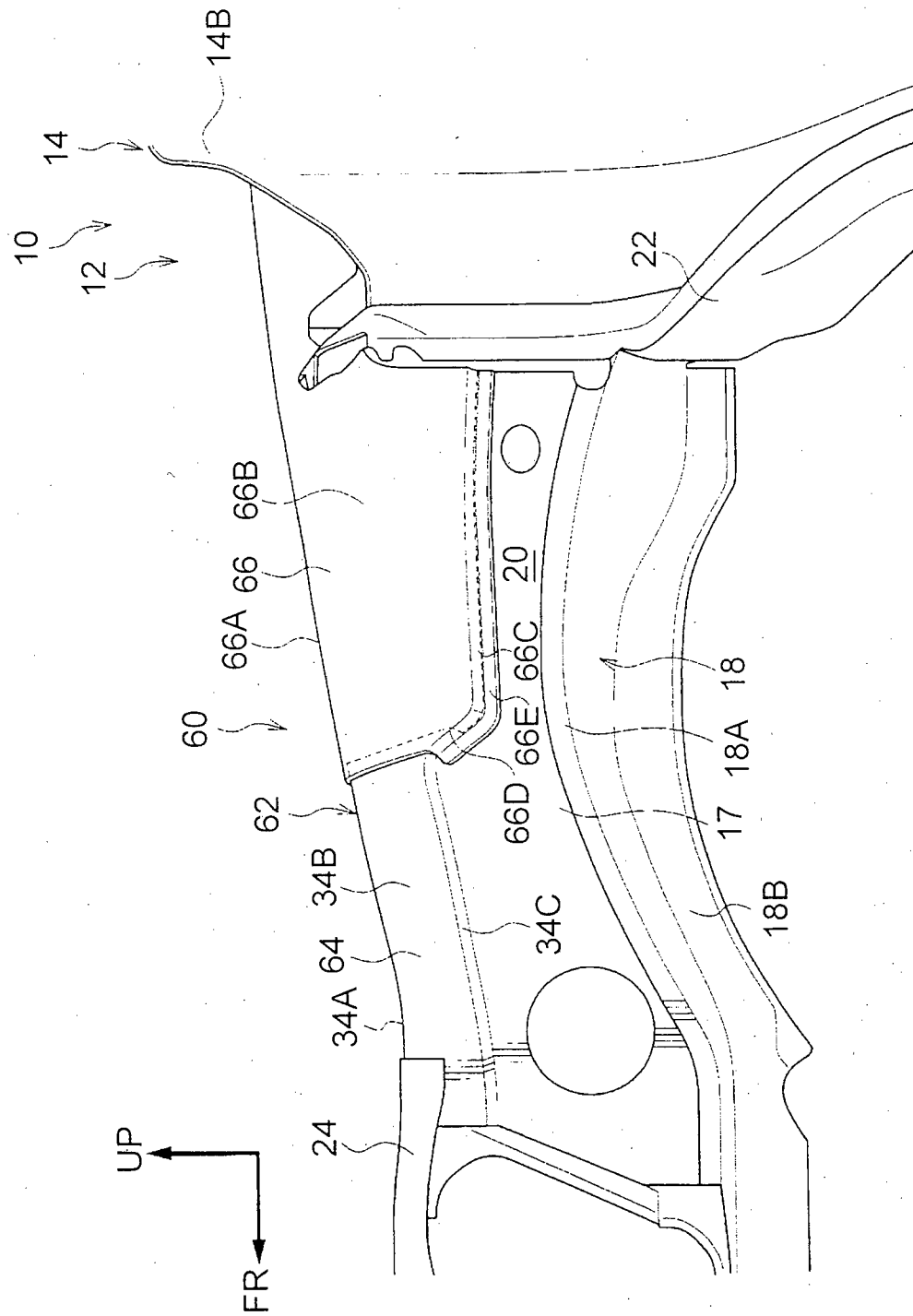


FIG. 5



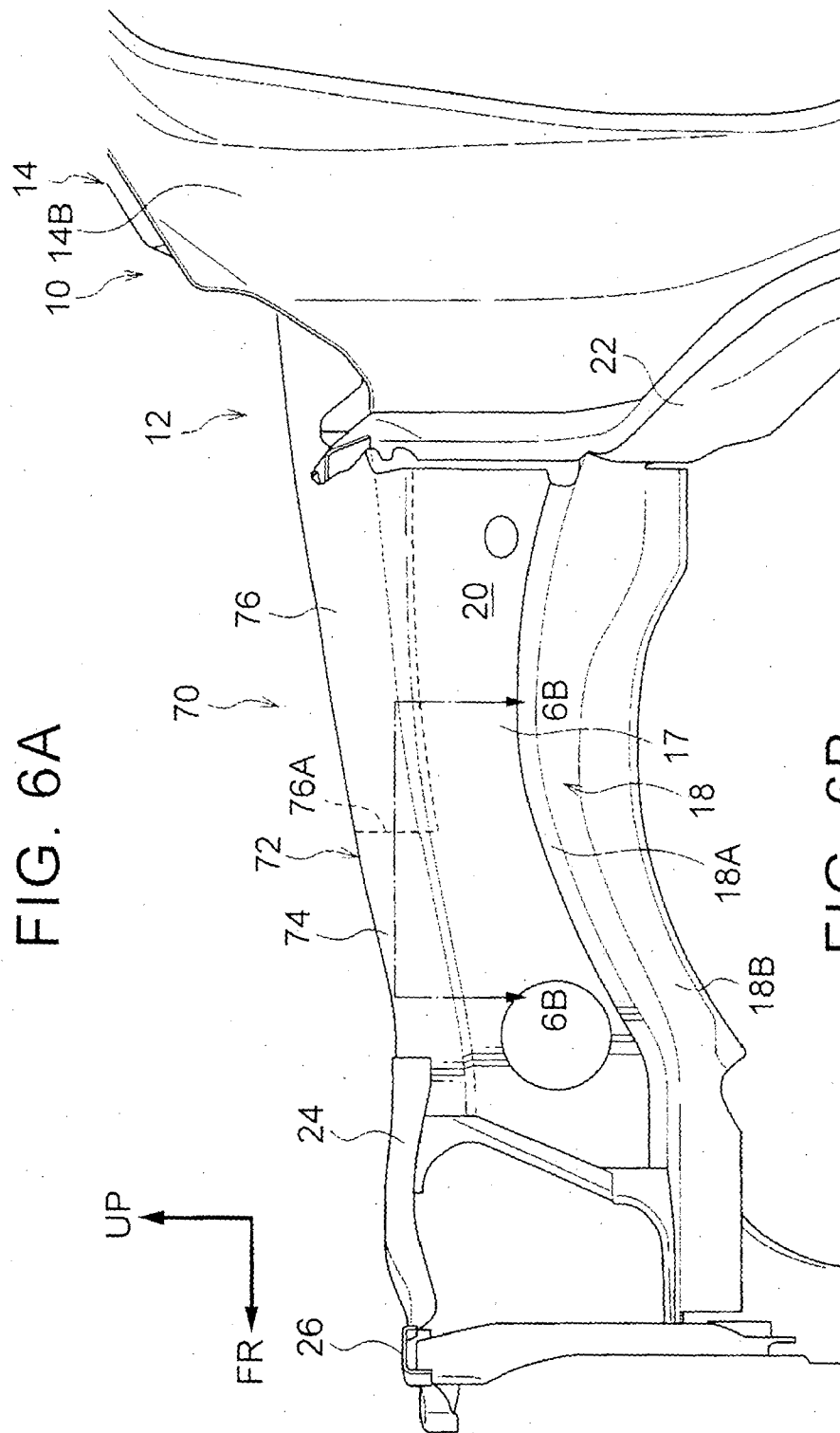
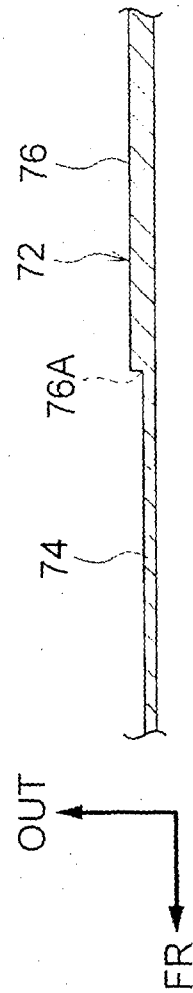


FIG. 6A



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FIG. 7

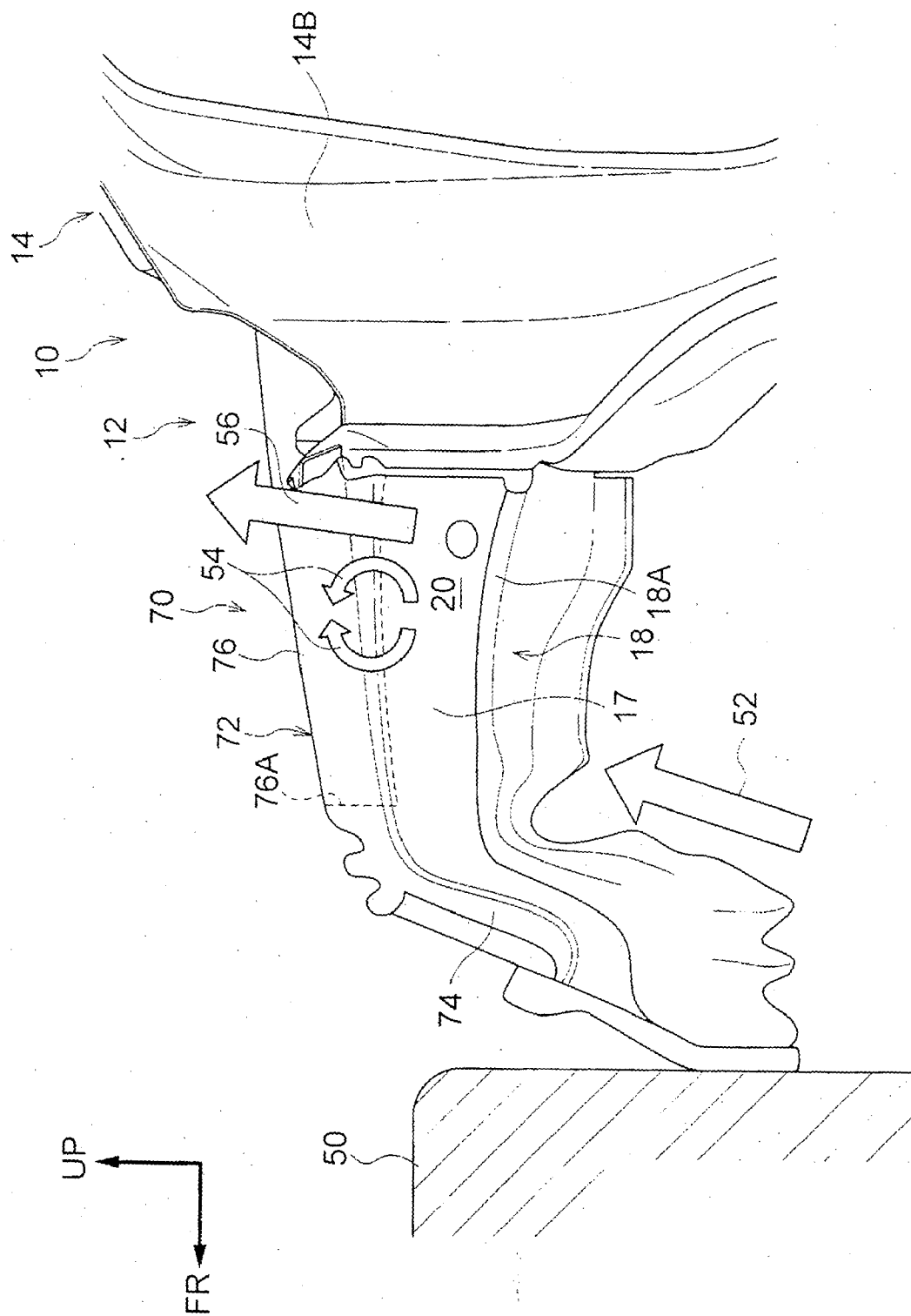
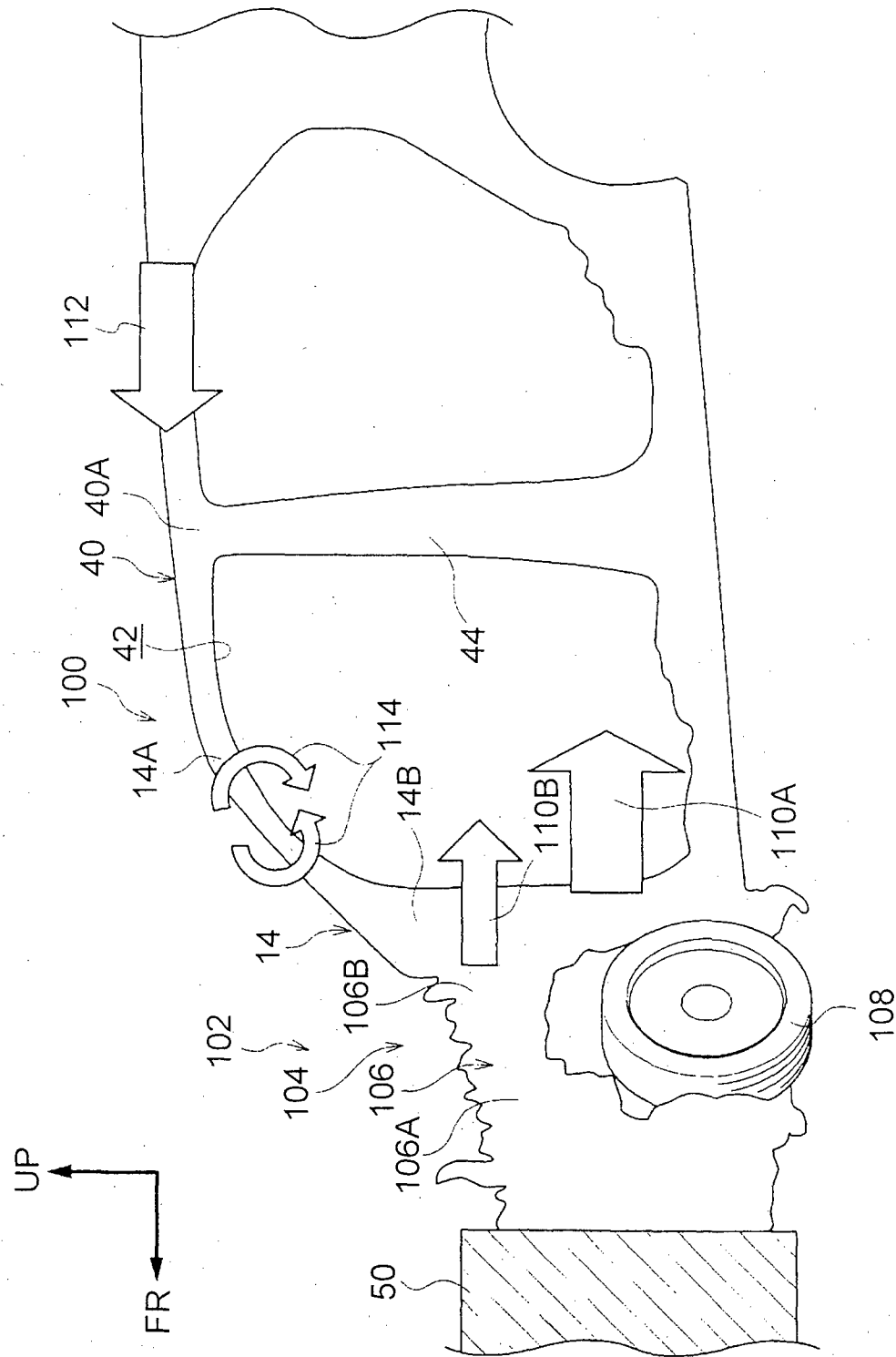


FIG. 8



INTERNATIONAL SEARCH REPORT

International application No

PCT/IB2014/001266

A. CLASSIFICATION OF SUBJECT MATTER

INV. B62D25/08

ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B62D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EP0-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2011/101732 A1 (BACCOUCHE MOHAMED RIDHA [US] ET AL) 5 May 2011 (2011-05-05) paragraph [0018] - paragraph [0019]; figures 1-4 paragraph [0025] paragraph [0030]	1,2,4
X	----- EP 2 570 334 A2 (MITSUBISHI MOTORS CORP [JP]) 20 March 2013 (2013-03-20) paragraph [0015]; figures 1,3,4 paragraph [0021] paragraph [0024]	1-4
X	----- US 6 139 093 A (ELLIOTT JEFFREY DARELL [US] ET AL) 31 October 2000 (2000-10-31) column 2, line 27 - column 3, line 3; figures 1-3 -----	1,2,4



Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

23 October 2014

Date of mailing of the international search report

30/10/2014

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/IB2014/001266

Patent document cited in search report	Publication date	Patent family member(s)	Publication date	
US 2011101732	A1	05-05-2011	CN 201559710 U	25-08-2010
			DE 102009013807 A1	17-12-2009
			US 2009315365 A1	24-12-2009
			US 2011101732 A1	05-05-2011

EP 2570334	A2	20-03-2013	CN 102991584 A	27-03-2013
			EP 2570334 A2	20-03-2013
			JP 2013060087 A	04-04-2013
			TW 201325965 A	01-07-2013
			US 2013062911 A1	14-03-2013

US 6139093	A	31-10-2000	NONE	
